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Service Manual
Electronic Analytical Balances

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KERN ABS

version 1.0

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Version 1.0

Service Manual

Electronic Analytical Balances

Contents

1. SERVICE MENU

1.1 How to enter the service menu mode

First, let the balance display the weight value.

(1) Hold down both the / OFF key and PRINT key simultaneously for three seconds or longer.

(2) Release both the ON / OFF key and PRINT key at the same time.

(3) Hold down both the CAL/MENU key and UNIT key simultaneously until the model name is displayed on the LCD.

The balance has now entered the service menu.

1.2 Contents of the service menu mode

Contents of the service menu are as follows:

Display on the LCD	Menu contents
E.AbS22	Model name
Lin-Adj	Linear adjustment
Lin-SEt	Inputting the weight values for linear adjustment
1.00-1.02	Software version No.
--End--	End of service menu (Returns to the weight display mode.)
EE oUt	Printing out the non-volatile RAM data (A printer dedicated for the balance is required.)
CAL SEt	Inputting the external weight value used for span calibration
-wAd-	A/D value of the load (Approx. 800,000 to 1,000,000 counts without any load on the weighing pan (1*): About 2.5 counts/0.1 mg)
-tAd-	A/D value of the temperature (15,000 to 17,000 counts at the temperature around 15°C)
-oAd-	A/D value of the load after temperature correction (unit:g) (The balance is normal when the zero point is approx. 1g. When it is 10g or more, the balance might be out of order.)
-LAd-	A/D value after temperature correction and linear correction (unit: g)

-wG-	Weight value
-bAt-	Power supply voltage (unit: V)
S.id-Set	Inputting serial no. (last five digits only)
Edit	Editing non-volatile RAM data
trAdE:on	Export specification setting (If set to export-specification, “E” is attached to the left of the model name.)
trAdE:oF	Domestic specification setting
--End--	End of service menu (Returns to the weight display mode.)

1.2.1 Model name

Displays the model name and the domestic / export setting condition.

“AbS 22” – AbS 220 for domestic specification setting
“E.AbS22” – AbS 220 for export specification setting

1.2.2 Linear adjustment

Linear adjustment can be executed by selecting “Lin-Adj”. (See 6.7 Linear adjustment.)

1.2.3 Inputting the weight values for linear adjustment

The weight values for linear adjustment can be input by selecting “Lin-SEt.” (See 6.7 Linear adjustment.)

Input the true weight values of the following weights.

for the balance with the maximum capacity of 320g:
50g, 100g, 150g, 200g, 230g, 300g, 350g

for Others:
50g, 100g, 150g, 200g, 230g

How to input: Pressing the UNIT key increases the numeral value at the blinking digit by one.
Pressing the PRINT key moves the digit by one.

To validate the input value, press the TARE key.
"SEt" will be displayed for several sec to inform you that the input has been validated.

1.2.4 Software version No.

Displays the software versions of the control CPU and the operational CPU.

“1. 00 - 1. 02”: The number in the left indicates the software version No. of the control CPU and the one in the right indicates that of the operational CPU.

1.2.5 Print out the non-volatile RAM data

By selecting “EE oUt”, non-volatile RAM data is output to the balance (EP-50 or EP-60A) connected.

1.2.6 Editing the non-volatile RAM data

By selecting “Edit”, the following display appears and the non-volatile RAM data can be edited.

[Example of display]

00 : 0123

0123 — Data is indicated by two bytes.

00 — Address

Meaning of the above display:

01 H is written at Address 00.
23 H is written at Address 01.

How to edit

- Pressing the CAL/MENU key increments the address by one.
- Pressing the UNIT key increases the numerical value of the blinking digit by one.
- Pressing the PRINT key moves the digit.
- Pressing the TARE key validates the data of the displayed address.

2. HOW TO INSPECT THE UNIT ASSY

<Disassembly and Inspection>

(1) Pull out the power cable and remove weighing pan (1*), draft shield ring (2*), and pan supporter assy (3*). (See Fig. 1 on page 41.)

(2) Remove the case assy. (See Fig. 1 on page 41.)

(2-1) Remove three screws (Semus M4 × 10) and dismount the case assy from the base.

(2-2) Pull out the operation cable from digital board assy (19*). Be careful not to damage the cable in this occasion.

(3) Remove the analog board cover and the inner case. (See Fig. 4 on page 43.)

(3-1) Remove two screws (Semus M3 × 6) and dismount the analog board cover.

(3-2) Pull out the detector output cable and the coil current cable from analog board assy (20*).

(3-3) Remove two screws (Semus M4 x 8) and remove the inner case.

Checkpoint 1: Check that the shake protector and the lever pin do not make contact and no dust exists between them. (See 6.3)

Checkpoint 2: Check the soldering of Pt-Ni band (15*) and check that coil assy (25*) is not disconnected. (See Fig. 9 on page 47.)

(4) Remove the magnet cover. (See Fig. 2-1 on page 42.)

Remove four screws (pan head screw M2.5 × 6) and dismount the magnet cover.

Note: Keep the magnet assy away from dust.

Checkpoint 3: Check that coil assy (25*) makes no contact with the magnet assy and no dust exist between them. (See Fig. 2-2 on page 42.)

- When they are in contact, loosen the tightening screws of the lever and coil assy (25*) to adjust the position of coil assy (25*).
- If any dust exits, clean coil assy (25*) and the magnet assy as follows.

How to clean coil assy (25*) and the magnet assy:

Remove the unit assy from the base. (Refer to Fig. 8 on page 46.)

Remove the magnet cover, then the magnet assy from the unit assy. (Refer to Fig. 2-3 on page 42.)

Clean coil assy (25*) and the magnet assy, taking the dust away from them by using scotch tape.

Note: Keep the unit away from dust.

Note: Do not hold the error adjustment lever. (Refer to Fig. 8 on page 46.)

(5) Inspection of fulcrum spring (13*), load spring (14*), and parallel guide (37*).
Inspect fulcrum spring (13*), load spring (14*), and parallel guide (37*) according to “3. INSPECTION AND REPLACEMENT OF FULCRUM SPRING, LOAD SPRING AND PARALELL GUIDE.”

<Reassembly>

(6) Assemble the magnet cover (4 pcs.) using four screws (pan head screw M2.5 × 6.) (See Fig. 2-1 on page 42.)

(7) Mount the inner case and the analog board cover. (See Fig. 4 on page 43.)
Note: Do not pinch a cable between the base and the inner case.

(8) Mount the case assy. (See Fig. 1 on page 41.)

(9) Mount draft shield ring (2*), pan supporter assy (3*), and weighing pan (1*). (See Fig. 1 on page 41.)

(10) Adjust the level of the balance, turn ON the power, and check the balance operation.

3. INSPECTION/REPLACEMENT OF THE FULCRUM SPRING, LOAD SPRING, AND PARALLEL GUIDE

3.1 How to dismount the unit assy

(1) Same as (1) in Section 2 “HOW TO INSPECT THE UNIT ASSY.”

(2) Same as (2) in Section 2 “HOW TO INSPECT THE UNIT ASSY.”

(3) Same as (3) in Section 2 “HOW TO INSPECT THE UNIT ASSY.”

(4) Remove the unit assy from the base.

Remove four screws (Semus M4 × 25) and dismount the unit assy from the base. (See Fig. 8 on page 46.)

Note: Keep the unit assy away from dust.

Note: Do not hold the eccentric error adjustment lever of the force cell frame. (See Fig. 8 on page 46.)

Checkpoint: Check that there is no strain, no crack, and/or no warp with upper and lower parallel guides (37*). (See Fig. 15 on page 50.)

3.2 Inspection and replacement of the fulcrum spring, load spring, and parallel guide

<Disassembly and Inspection>

Preparation: Disassemble and assemble the unit assy at a location free from dust. Attention must be paid to prevent dust from entering the clearance between parallel guide (37*) and the force cell frame, and the clearance between the shake protector and the pins for lever.

(1) Remove the blue and the yellow lines connected to the temperature sensor from detector assy (21*) using a soldering iron. (See Fig. 10 on page 47.)

(2) Remove Pt-Ni band (15*) using a soldering iron. Remove a screw (Semus M4 × 12) to dismount the relay board from the force cell frame. (See Fig. 9 on page 47.)

(3) Loosen the nut with a wrench and remove the screw bar to which balance weight (33*) and eccentric weight (*28) are attached, from the lever.

Note: Be sure to perform the work with a shake protector attached. (See Fig. 10 on page 47) Otherwise, the spring might be damaged.

(4) Remove two screws (M4 × 6) and dismount the shake protector from the force cell frame. (Refer to Fig. 10 on page 47.)

Note: Be careful not to bend fulcrum spring (13*) and load spring (14*).

Replacing coil assy (25*):

By removing the magnet cover and the connection screw between the lever and coil assy (25*), the coil assy can be replaced. (See Fig. 2-3 on page 42.)

(5) Remove one screw (bolt with a hole, SPG washer, small flat washer) and dismount the pan supporter assy. (See Fig. 15 on page 50.)

Checkpoint: Check if there is any strain, crack, and/or warp with fulcrum spring (13*) and load spring (14*).

(6) Remove fulcrum spring (13*) and load spring (14*) with a hex wrench. (See Fig. 13 on page 49.)

Checkpoint: Check if there is any strain, crack, and/or warp with fulcrum spring (13*) and load spring (14*).

(7) Remove four screws for parallel guide (36*) respectively and dismount upper and lower parallel guides (37*). (See Fig. 15 on page 50.)

Note: Do not lose the eccentric error adjustment spacer (34*) placed under parallel guide (37*).

Note: Do not forget the original location of the eccentric error adjustment spacer (34*) as it must be mounted on that location when reassembled.

Checkpoint: Check if there is any strain, crack, and/or warp with upper/lower parallel guides (37*).

<Reassembly>

(8) Assemble upper/lower parallel guides (37*). (See Fig. 15 on page 50.)

Note: Align the mount hole of parallel guide (37*) and that of the force cell frame at the center.

Note: Place the eccentric error adjustment spacer between the upper portion of the column and parallel guide (37*) where it was placed before, and then fix it with a screw. (18 kgf•cm)

Note: Do not use a used screw to fix parallel guide (36*).

(9) Assemble fulcrum spring (13*) and load spring (14*) with the following procedure. (See Fig. 14 on page 49.)

(a) Place each spring so that the mount holes of fulcrum spring (13*) and load spring (14*), are aligned with the center of those of the unit assy.

(b) Insert spring set pin (24*) into the upper hole and lightly tighten the lower bolt ensuring that each spring will not move. (See Fig. 14-1)

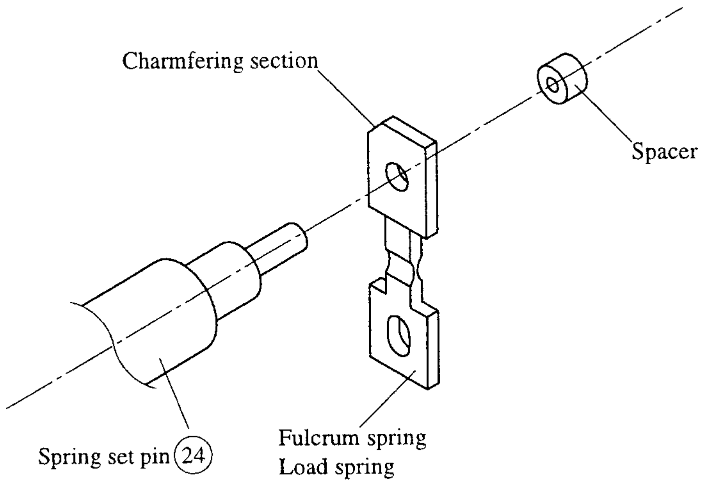


Fig. 14-1

(c) Tighten the lower bolt with 20 kg•cm ensuring that each spring will not move.

(d) Tighten the upper screw with the torque free washer touching the end surface of the lever to prevent the spring from rotating together. (Torque 20 kg•cm) (See Fig. 14-2)

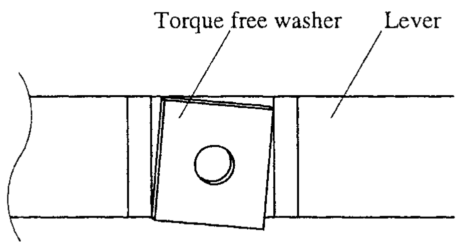


Fig. 14-2

(e) Check if each spring is not bent or cracked.

Note: When replacing fulcrum spring (13*) and load spring (14*), replace three of them together at one time.

Note: Use the regular bolts, washers, and cup washers (26*) only.

Note: Do not use a used cup washer (26*) again.

(10) Remove the magnet cover and after adjusting the position of coil assy (25*) (using a screw), mount the magnet cover. (See Fig. 2-2 on page 42.)

(11) Fix the pan supporter assy with screw. (See Fig. 15 on page 50.)

Note: Tighten the screw with the torque of 25 kg•cm using a hex torque wrench.

Note: Mount the pan supporter so that it is visually parallel to the lever.

(12) Remove assembly jig for the AX series (22*) from the unit assy. (See Fig. 14 on page 49.)

Note: Remove jig screws A3, A2, and A1 in this order.

(13) Incorporate the shake protector so that it does not make contact with the lever pin.

Checkpoint: Make adjustment according to “6.3 Adjustment of the shake protector.”

(14) Mount the screw bar to which balance weight (33*) and eccentric weight (28*) are attached to the lever. (See Fig. 12 on page 48.)

Checkpoint: Make adjustment according to “6.4 Adjustment of mechanical balance and level.”

(15) Mount the relay board and solder Pt-Ni band (15*). (See Fig. 9 on page 47.)

(16) Solder two temperature sensor lines to A and B of detector assy (21*).

Note: Connect the yellow line to A and blue line to B.

4. PART REPLACEMENT

4.1 Replacement of the power board assy

(1) Same as (1) in Section 2 “HOW TO CHECK THE UNIT ASSY.”

(2) Same as (2) in Section 2 “HOW TO CHECK THE UNIT ASSY.” (See Fig. 5 on page 44 for the following.)

(3) Pull out the flat cable (26P) from power board assy (18*).

(4) Remove two screws (hex screws) at the RS232C connector portion using a box driver.

(5) Remove three screws (Semus M3 × 8 and Semus M4 × 8) and dismount power board assy (18*) from the base.

(6) Set new power board assy (18*) and fix it to the base with three screws.

(7) Tighten two screws (hex screws) at the RS232C connector portion.

(8) Connect the flat cable (26P) to power board assy (18*).

Note: The red line must be located in the left as viewed from the rear of the balance.

4.2 Replacement of the digital board assy

(1) Same as (1) in Section 2 “HOW TO CHECK THE UNIT ASSY.”

(2) Same as (2) in Section 2 “HOW TO CHECK THE UNIT ASSY.” (See Fig. 5 on page 44 for the following.)

(3) Pull out all the cables from digital board assy (19*).

(4) Remove four screws (Semus M4 × 8) and dismount digital board assy (19*) from the base.

(5) Mount new digital board assy (19*) to the base with four screws (Semus M4 × 8).

(6) Connect all the cables to digital board assy (19*).

4.3 Replacement of the analog board assy

(1) Same as (1) in Section 2 “HOW TO CHECK THE UNIT ASSY.”

(2) Same as (2) in Section 2 “HOW TO CHECK THE UNIT ASSY.” (See Fig. 4 on page 43 for the following.)

(3) Remove two screws (Semus M3 × 6) and dismount the analog board cover.

(4) Pull out all the cables from analog board assy (20*).

(5) Remove two screws (Semus M3 × 10) and dismount analog board assy (20*) from the inner case.

Note: Do not lose the spacer nut (type 1 M4).

(6) Place the spacer nut (type 1 M4) between new analog board assy (20*) and the inner case and fix it with two screws (Semus M3 × 10).

(7) Connect all the cables and mount the analog board cover.

4.4 Replacement of the detector assy

(1) Same as (1) in Section 2 “HOW TO CHECK THE UNIT ASSY.”

(2) Same as (2) in Section 2 “HOW TO CHECK THE UNIT ASSY.” (See Fig. 4 on page 43 for the following.)

(3) Remove two screws (Semus M3 × 6) and dismount the analog board cover.

(4) Pull out the detector output cable from analog board assy (20*).

(5) Remove two screws (Semus M4 × 8) and dismount the inner case from the base.

(6) Remove two screws (Semus M3 × 8) and dismount detector assy (21*).

(7) Mount new detector assy (21*).

(8) Connect the detector output cable.

(9) Turn ON the power and adjust the height and the volume control of detector assy (21*). See “6.2 Height Adjustment of the Detector Assy.”

(10) Mount the inner case.

(11) Mount the analog board cover.

4.5 Replacement of the switch panel

(See Fig. 6 on page 45 for the following.)

(1) Remove switch panel (9*).

(2) Wipe off dirt on the dented portion.

(3) Paste new switch panel (9*).

5. ASSEMBLING THE CASE ASSY

(1) Remove four screws (M4 $\times$ 6) and dismount the back plate. (See Fig. 16 on page 51.)

(2) Remove pull (29*) and pull fixer (30*) from side glass assy (5* and 6*), and pull them out from the case assy.

Note: As it is bonded with double-faced tape, carefully remove them using a precision driver.

Note: Attention should be paid not to lose the flat spring as it is placed between side glass assy (5* and 6*) and the case roof assy.

(3) Remove two nuts and disassemble the case, the draft shield column, and the case roof assy. (See Fig. 17 on page 52.)

Note: Front glass assy can be dismounted by loosening the nuts.

Note: If side glass assy (5* and 6*) do not move smoothly when assembled, apply Teflon on the end surface of the glass by a piece of cloth on which PTFE spray (39*) is blown.

6. BALANCE ADJUSTMENT

6.1 Adjustment procedure of the balance

The balance shall be adjusted on condition that the case assy, inner case, and analog board cover are dismounted, and the key switch assy is connected to digital board (19*).

Adjust the balance with the following procedure.

(1) Turn ON the power and enter the service menu (see 1.1).

(2) Height adjustment of detector assy (21*). (See. 6.2)

(3) Mount the shake protector. (See. 6.3)

(4) Adjustment of the mechanical balance and the level. (See 6.4)

(5) Rough adjustment of eccentric error (See 6.5)

(6) Mount the inner case. (See Section 2.(3))

(7) Mount the analog board cover. (See Section 2.(3))

(8) Perform span calibration “E CAL” using the external weight.

(9) Push weighing pan (1*) with your hand to check the repeatability and stability at zero point.

(10) Mount the case assy on the base. (See Section 2.(2))

(11) To perform the following adjustment correctly, warm-up the balance for 30 min.

(12) Fine adjustment of eccentric error (See 6.6)

(13) Repeatability check (See 7.2)

(14) Linearity adjustment (See 6.7)

(15) Linearity check (Return to 14 if the performance specifications are not satisfied.) (See 7.4)

6.2 Height adjustment of the detector ASSY

(1) Pull out the 2-pin coil current cable from analog board assy (20*). (See Fig. 4 on page 43)

(2) Adjust the variable resistance of detector assy (21*) and position of detector assy (21*) so that the lever displacement output voltage (CP2) of detector assy (21*) becomes +2V max. and -2V min.

Note: The lever displacement signal varies to plus (+) direction when the lever is moved up and varies to minus (-) direction when it is moved down.

Note: Adjust the maximum voltage and the minimum voltage of the lever displacement signal “within 0.2 V ± specified voltage.”

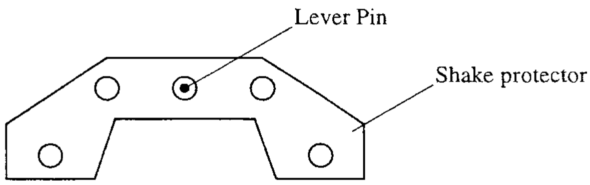
(3) Fix detector assy (21*) to the force cell frame with two screws (Semus M3 $\times$ 10), measure the lever displacement output voltage again, and confirm that the Max. value and the Min. value are within the above specified voltage range.

(4) Connect 2-pin coil current cable to analog board assy (20*), flip the lever by hand, and confirm that the lever displacement output returns to 0V.

6.3 Adjustment of the shake protector

(1) Loosely fix the shake protector to the force cell frame with screws. (See Fig. 10 on page 47)

(2) Tighten two screws of the shake protector alternatively while moving up and down the screw bar to which balance weight (33*) and eccentric



weight are attached (28*) .

Fig. 11

Note: The screw bar becomes hard to move up/down if the lever pin is in contact with the shake protector. (See Fig. 11)

Note: Be careful not to damage fulcrum spring (13*) and load spring (14*).

(3) Confirm that the shake protector does not make contact with the lever pin using a magnifying glass.

Note: Confirm that no dust attaches to this portion.

6.4 Mechanical balance and level adjustment

(1) Adjust the level of the base while observing the level-indicator.
(See Fig. 12 on page 48 for the following.)

(2) Move balance weight (33*) so that the wAD value at zero point becomes between 800,000 and 1,000,000, and keep this wAD value in your memory.

(3) Place a plate with the thickness of 2.0 mm under left front level assy (12*) viewed from the front of the balance and check how the wAD value varies.

(4) Perform the following adjustment until the difference between the wAD value in (2) and wAD value in (3) becomes 250 or less.

If wAd value in (2) < wAD value in (3), rotate eccentric weight (28*) toward lower direction.

If wAd value in (2) > wAD value in (3), rotate eccentric weight (28*) toward upper direction.

Note: 250 counts of the wAD value is equivalent to approx. 10 mg.

(5) Rotate balance weight (33*) to fix balance weight (33*) and eccentric weight (28*) to the screw bar.

6.5 Rough adjustment of the eccentric error

The aim of rough adjustment of the eccentric error is to confirm that the eccentric error can be adjusted while observing the displayed value on the LCD.

Follow the procedure below.

(1) Mount the inner case to the base.

(2) Prepare the following weights.

For the balance with the maximum capacity of 120 g 50 g weight

For the balance with the maximum capacity of 220 g/200 g 100 g weight

(3) Load the weight at the center on weighing pan (1*) and press the TARE key to display 0.0000 g.

(4) Regard the value displayed when the weight is moved to X position on weighing pan (1*) as X g. (See Fig. 18 on page 20)

(5) Regard the value displayed when the weight is moved to Y position on weighing pan (1*) as Y g. (See Fig. 18 on page 20)

(6) Make adjustment until the absolute values of X g and Y g becomes 10 mg or less respectively.

When X g is a plus (+) value, loosen the eccentric error adjustment screw P.

When X g is a minus (-) value, tighten the eccentric error adjustment screw P.

When Y g is a plus (+) value, loosen the eccentric error adjustment screw Q.

When Y g is a minus (-) value, tighten the eccentric error adjustment screw Q.

6.6 Fine adjustment of eccentric error

(1) The case assy must be mounted on the base.

(2) Same as (2) in “6.5 Rough adjustment of the eccentric error.”

(3) Load the weight at the center of weighing pan (1*) and press the TARE key to display 0.0000 g.

(4) Regard the value displayed when the weight is moved to X position on

weighing pan (1*) as X g. (See Fig. 18)

(5) Regard the value displayed when the weight is moved to Y position on weighing pan (1*) as Y g. (See Fig. 18)

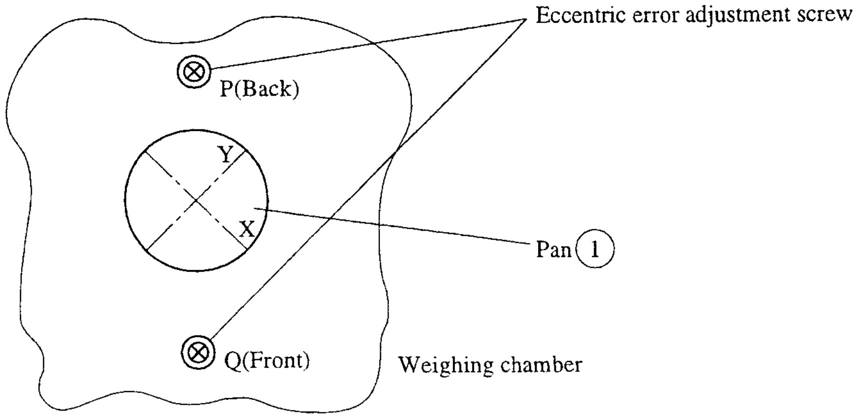


Fig. 18

(6) Make adjustment until the absolute values of X g and Y g are 0.5 mg or less respectively.

When X g is a plus (+) value, loosen the eccentric error adjustment screw P.

When X g is a minus (-) value, tighten the eccentric error adjustment screw P.

When Y g is a plus (+) value, loosen the eccentric error adjustment screw Q.

When Y g is a minus (-) value, tighten the eccentric error adjustment screw Q.

6.7 Linearity adjustment

(1) Select "Lin-SEt" in the service menu and input the weight value for linear adjustment. (See 1.2.3)

(2) Select "Lin-Adj" in the service menu and execute linear adjustment. (See 1.2.2)

7. PERFORMANCE CHECK OF THE BALANCE

7.1 Environment and conditions for checking the balance

- Room temperature: Room temperature from 20ºC to 30ºC and temperature variation of 1ºC/H is desirable.
- Humidity: The humidity must not be extremely high or low. Humidity from 40% to 70% is desirable.
- Installation site: The balance should be placed at the location free from blowing wind and vibration.
- Warm-up operation: Warm up is required for more than 30 min.
- Setting of the balance: Must be set to “St bl.”

Cautions at inspection

- Place the weight in the weighing room beforehand so that the balance can be inspected without temperature difference between the weight and the weighing room.
- Use a pair of long tweezers to load/unload the weight and avoid entering your hand into the weighing room.

7.2 Repeatability check

(1) Weight to be prepared (or the equivalent)

For the balance with the maximum capacity of 120 g 100 g weight

For the balance with the maximum capacity of 220 g /200 g 200 g weight

(2) Operation

Load/unload the above described weight on/from the weighing pan (1*) seven times respectively and record the values displayed when the stability mark appears.

Note: When loading the weight on the weighing pan (1*), place it at the center of the pan (1*).

Note: With the large drift (both at the 0 point and at the span point), even a normal balance may have the standard deviation of 0.15 mg or more.

(3) Evaluation

The balance is normal if the standard deviation of the displayed value is 0.10 mg or less when loading/unloading the weight. ($\sigma < 0.10$ mg)

7.3 Eccentric error check

(1) Weight to be prepared (or the equivalent)

With the maximum capacity of 120g	50 g weight
With the maximum capacity of 220 g/200 g	100 g weight

(2) Operation

Place the weight at the center of weighing pan (1*) and let the balance display “000.0000 g” by pressing the TARE key with the stability mark lit.

Next, move the weight back/forth and right/left on weighing pan (1*) and record the value displayed at each position.

(3) Evaluation

The balance is normal when the difference in values is 0.5 mg or less between when the weight is in the center position and when it is in the eccentric position.

7.4 Linearity inspection

(1) Weight to be prepared (or equivalent)

With the maximum capacity of 120 g	weights of 20 g, 50g, and 100 g
With the maximum capacity of 220g/200g	weights of 50g, 100g, and 200g

Note: Each weight value can be checked by the precision of 0.1 mg.

(2) Operation (Example)

Following is the description of the example operation procedure for the balance whose capacity is 120g.

A. Press the TARE key with the stability mark lit with 0 g load on weighing pan (1*).

B. Load 120 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

C. Make the load 0 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

D. Load 20 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

E. Load 50 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

F. Load 100 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

G. Make the load 0 g on weighing pan (1*) and record the value displayed

when the stability mark is lit.

H. Load 120 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

I. Make the load 0 g on weighing pan (1*) and record the value displayed when the stability mark is lit.

(3) How to calculate

How to calculate the linearity error based on the above example operation is described as follows.

The actual mass amount of the weight used shall be as follows.

Nominal value of weight	Actual mass of weight
20 g	19.9994 g
50 g	49.9985 g
100 g	100.0010 g

The values recorded through the above operation are as follows.

	Weight	Measurement value
A	0 g	0.0000 g
B	120 g	120.0002 g
C	0 g	-0.0001 g
D	20 g	19.9992 g
E	50 g	49.9983 g
F	100 g	100.0005 g
G	0 g	-0.0002 g
H	120 g	120.0000 g
I	0 g	-0.0003 g

Initially, obtain the reference value of 20g point.

The reference value against the actual mass amount of 120.0004g (19.9994g + 100.0010g) becomes 120.00025g calculated with the following equation.

[{B - (A + C) /2}+ {H - (G + I) /2}] /2

= [{120.0002g - (0.0000g - 0.0001g) /2}

+ {120.0000g - (-0.0002g - 0.0003g) /2}]/2

= 120.00025g

Accordingly, the reference value against the true mass amount of 120g is 119.99985g calculated with the following equation.

120.00025g*(120.0000g/120.0004g) = 119.99985g

If the balance has no linearity error, the reference value against the true mass amount 20g is 19.999975g calculated with the following equation.

119.99985g*(20.0000g/120.0000g) = 19.999975g (A)

Next, obtain the measurement value at 20g point.

The measurement value against the actual mass amount of 19.9994g is 19.99935g calculated with the following equation.

D - (C+G) /2

= 19.9992g - (-0.0001g - 0.0002g) /2

= 19.99935g

The measurement value against the true mass amount of 20.0000g is 19.99995g calculated with the following equation.

19.99935g* (20.0000g/19.9994g) = 19.99995g (B)

Lastly, the linearity error at 20g point is -0.000025 g calculated with the following equation.

(B) - (A) = 19.99995g - 19.999975g = -0.000025g

Similarly, the linearity errors against other mass amounts are as follows.

Linearity error at 50 g point is 0.00001 g.

Linearity error at 100 g point is -0.00023 g.

(4) Evaluation

The balance is normal if the absolute value of linearity error is 0.2mg or less.

8. PART LIST

"No. in this manual", "Name in this manual", "Order name", and "Order No." are listed in the following table.

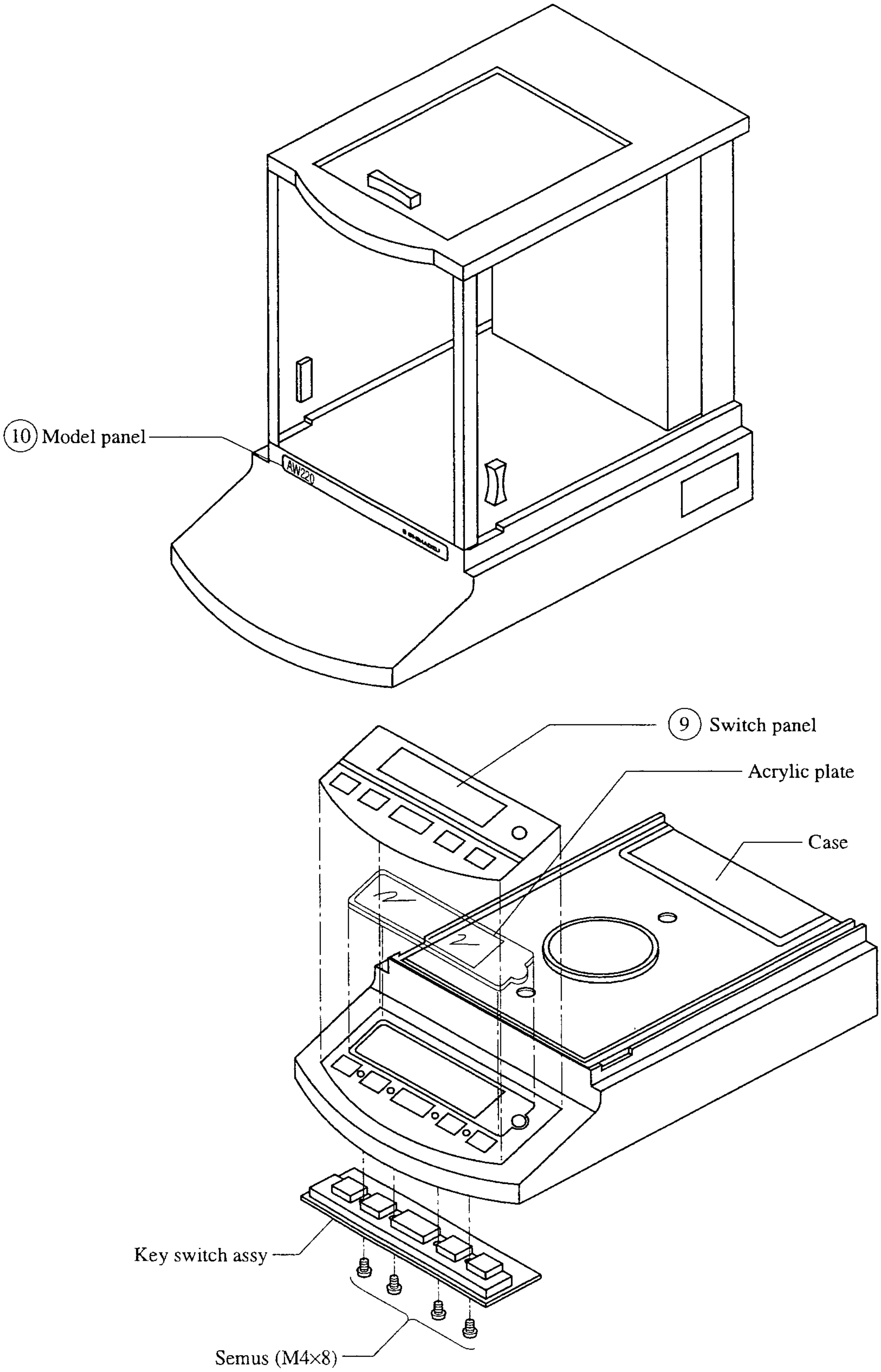
To order the parts, inform us of both the "Order name" and the "Order No.."

The "No. in this manual" is the No. in the parenthesis with * attached to the right shoulder.

Example of a No. in this manual: weighing pan (1*)

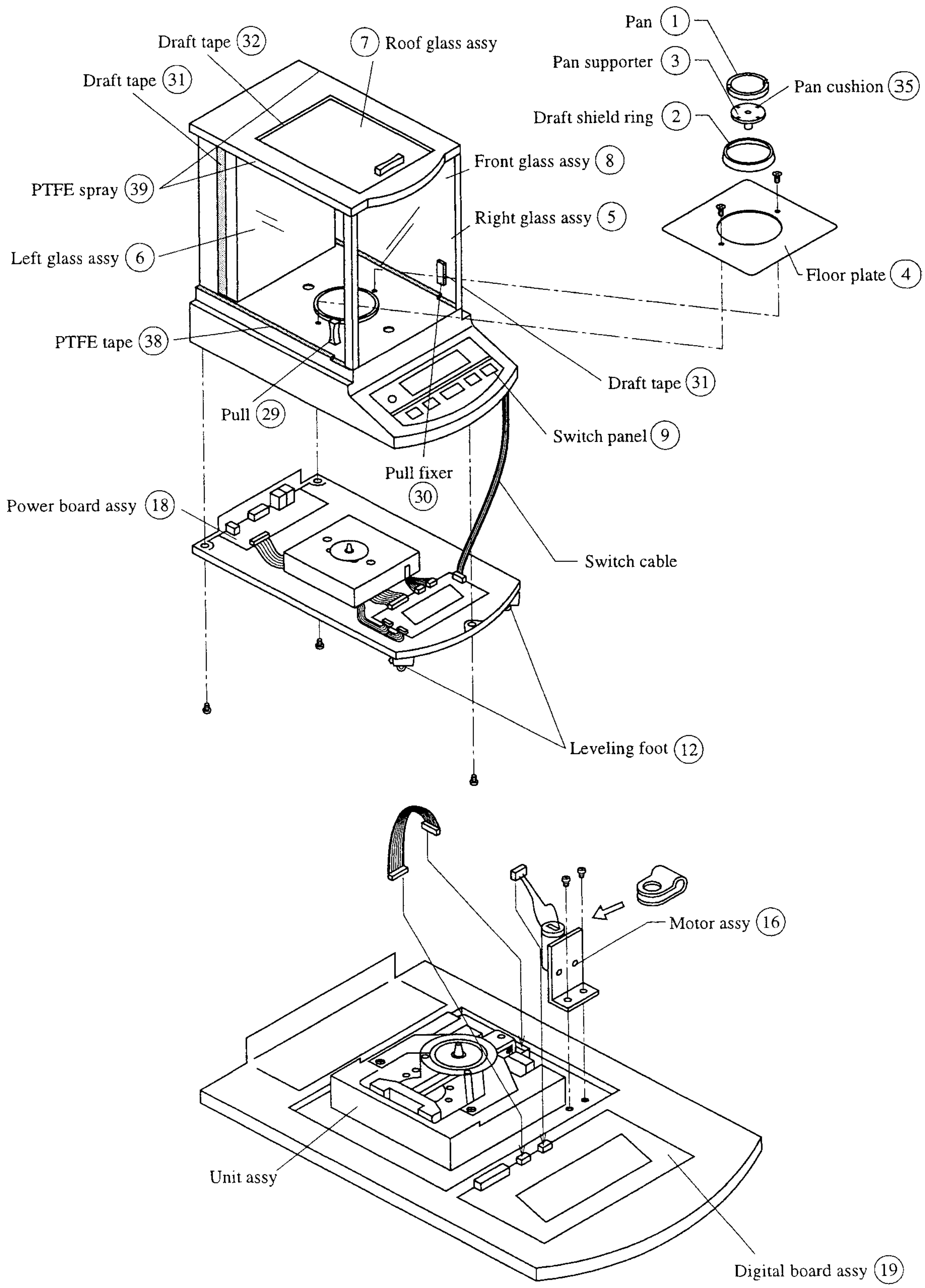
No. in this manual	Name in this manual	Order name	Order No.	Remarks
1	Pan	PAN (PRESS)	321-60453	
2	Draft shield ring	WIND SHIELD RING	321-41205	
3	Pan supporter	PAN SUPPORTER ASSY	321-60459	
4	Bottom plate	COVER PLATE	321-60437	
5	Right glass assy	SIDE GLASS RIGHT ASSY	321-60445	
6	Left glass assy	SIDE GLASS LEFT ASSY	321-60444	
7	Roof glass assy	ROOF GLASS ASSY	321-60468	
8	Front glass assy	FRONT GLASS ASSY	321-60535	
9	Switch panel	DSP PANEL	321-60533-11	
10	Model panel	LABEL, TYPE NAME	321-60534-23	ABS220
10	Model panel	LABEL, TYPE NAME	321-60534-22	ABS120
11	Level	LEVEL	321-53128-03	
12	Leveling foot	FOOT WHEEL ASSY	321-53530-30	
13	Fulcrum spring	SPRING FORCE POINT	321-54744-02	
14	Load spring	SPRING FORCE POINT	321-53700-05	
15	Pt-Ni band	Pt-Ni BAND	014-54301	
16	Motor assy	MOTER ASSY	321-60520	
17	AC adapter (Domestic)	AC ADOPTOR (JAPAN)	321-60132	
17	AC adapter (Overseas)	AC ADOPTOR (OVERSEA)	074-83004-01	
18	Power board assy	BOARD ASSY, POWER	321-60235	
19	Digital board assy	PCB ASSY, AX DIGITAL	321-55244-04	
20	Analog board assy	BOARD ASSY, ANALOG	321-60234-01	
21	Detector assy	DETECTOR ASSY	321-60521-01	
22	Assembling jig for AX series	ASSEMBLING JIG	321-60209	
23	Screw of jig	SCREW OF JIG	321-60223-01	Long
23	Screw of jig	SCREW OF JIG	321-60223-02	Short
24	Spring set pin	SPRING SET PIN	321-54849-27	
25	Coil assy	FORCE COIL ASSY	321-53912	
26	Cup washer	DISC SPRING	321-28765-01	
27	Rubber washer	WASHER RUBBER	321-60587	
28	Eccentric weight	CENTER OF CRAVITY	321-60756-01	
29	Pull	PULL	321-60518	
30	Pull fixer	PULL STOPPER	321-60519	
31	Draft tape	DRAFT TAPE	321-60515-01	
32	Draft tape	DRAFT TAPE	321-60515-02	
33	Balance weight	BALANCE WEIGHT	321-31133-04	
34	Eccentric error adjustment spacer	SPACER 4-CORNER	321-60522-01	

No. in this manual	Name in this manual	Order name	Order No.	Remarks
35	Pan cushion	CUSHION	321-50746-01	
36	Screw for parallel guide	SCREW PAN WITH WASHER	321-40051	
37	Parallel guide	PARALLRL GUIDE B	321-51983-08	
38	PTFE tape	PTFE TAPE	320-00070	
39	PTFE spray	PTFE SPRAY	321-61141	
40	EEPROM	IC. NM93C 56N	075-11957-13	
41	FLAT WASHER	WASHER, BS-FLAT	023-62040	



10 Model panel
AW220
9 Switch panel
Acrylic plate
Case
Key switch assy
Semus (M4×8)

Fig. A



Pan (1)
Pan supporter (3)
Pan cushion (35)
Draft shield ring (2)
Draft tape (32)
(7) Roof glass assy
Draft tape (31)
Front glass assy (8)
PTFE spray (39)
Right glass assy (5)
Left glass assy (6)
Floor plate (4)
PTFE tape (38)
Draft tape (31)
Pull (29)
Switch panel (9)
Pull fixer (30)
Power board assy (18)
Switch cable
Leveling foot (12)
Motor assy (16)
Unit assy
Digital board assy (19)

Fig. B

9. TROUBLESHOOTING

9.1 List of troubles

(1) “CAL E2” (Error message)
(2) “CAL d” (Error message)
(3) “ERR01” (Error message)
(4) “ERR05” (Error message)
(5) Span calibration (CAL) time is long.
(6) Display is abnormal.
(7) “A CAL” frequently appears.
(8) The display deviates after the stability mark appears.
(9) Some sound is heard from the balance.
(10) Nothing appears on the display.
(11) The switch(es) on the front panel does(do) not work.
(12) The display becomes unstable when something is loaded on weighing pan (1*).
(13) Dispersion, fluctuation, zero drift, and poor return of zero point.

9.2 Countermeasures for each trouble

9.2.1 “CAL E2”

Meaning:

This is an error message indicating that zero point deviates at the time of span calibration (CAL.)

“CAL E2” appears when span calibration is performed with something loaded on weighing pan (1*) or the balance condition has gone wrong due to some reason(s).

The judgement standard of the zero point differs between the first calibration after the power is turned ON and the second or later calibration.

In the first calibration after the power is turned ON, “CAL E2” appears when the zero point deviates (10 g from the normal state (zero point at the time of adjustment.)

In the second or later calibration after the power is turned ON, "CAL E2" appears when the zero point deviates (1 g from that of the first calibration after the power is turned ON.

Cause:

“CAL E2” is caused by the incorrect use of the balance or by the

hardware failure of the balance.

As the incorrect use of the balance, the following cases may be considered.

- Level adjustment has been performed during span calibration when the power is turned ON.
- Something was loaded on weighing pan (1*) during span calibration.

If “CAL E2” appears every time the power is turned ON, the following may be considered as causes.

- Disconnection or leak of coil assy (25*)
- The shake protector makes contact with the lever pin.
- Fulcrum spring (13*) or load spring (14*) are damaged.
- Normal operation cannot be performed due to the failure of the electric board assy.

When “CAL E2” appears occasionally, the following may be considered as causes.

- The balance is used incorrectly.
- Failure of the hardware

9.2.2 “CAL d”

Meaning:

This is an error message indicating that the measured value has dispersion or fluctuation at the time of span calibration (CAL).

“CAL d” appears when the balance is shook, large vibration exists, or the balance has dispersion in the measured values during span calibration. Even though “CAL d” is displayed, the balance can be used by pressing the ON / OFF key.

Causes:

The following may be considered as causes.

- The level adjustment of the balance is performed during span calibration.
- The balance door was open during span calibration.
- The balance base was shaken during span calibration.
- There was large vibration during span calibration.
- The balance has dispersion.

9.2.3 “Err 01”

Meaning:

This is an error message indicating that the temperature signal (tAD value of the service menu) is inappropriate.

Causes:

The following may be considered as causes.

- Faulty connection between the temperature sensor and the detector assy (21*).
- Faulty analog board assy (20*) or faulty digital board assy (19*) See "9.3.4 Temperature signal check."

9.2.4 “Err 05”

Meaning:

This is an error message indicating that the data stored in the non-volatile memory has been deleted.

“ERR 05” appears when the correction coefficient at the zero point and span point or the correction coefficient of linearity have been rewritten for some reason.

Cause:

The data stored in the non-volatile memory has been destroyed.

9.2.5 Span calibration (CAL) time is long.

The time required for span calibration is approx. 40 to 50 sec. when power is turned ON. Even if span calibration takes a long time, the balance can be used if “CALEnd” appears.

The span calibration consists of the following three steps.

- “CAL 2” being displayed: Measurement at zero point
- “CAL 1” being displayed: Measurement at span point
- “CAL 0” being displayed: Measurement at zero point

At each step of the calibration, if the fluctuation range of the measurement data is within three counts, the calibration proceeds to the next step in 15 sec., and if it is approx. 45 counts or more, “CAL d” appears after the end of span calibration.

Cause:

The causes for long calibration time is according to the description in “9.2.2 CAL d.”

See “9.3.3 Display when the power is turned ON.”

9.2.6 Display is abnormal

Cause:

The cause for the appearance of something like signs that are not displayed at the normal state is the faulty digital board assy (19*).

9.2.7 “A CAL” appears frequently

Meaning of “A CAL”:

When the temperature inside the balance changes 0.5ºC or more from that of the previous span calibration, automatic span calibration starts and “A CAL” appears.

It is not abnormal when “A CAL” appears once in 20 to 30 min at the air-conditioned place.

0.5ºC of temperature change corresponds to ±1 PPM change of weight.

If you have trouble of “A CAL” appearing frequently, use the balance with “A CAL” set to “OFF.”

Cause:

See “9.3.4 Checking the temperature sensor signal” and judge whether it is caused by failure of the balance.

9.2.8 The display deviates after stability mark (→) appears

Cause:

When the display deviates after stability mark appears but the stopped value does not have dispersion, poor installation environment of the balance may be the cause.

In this case, the deviation amount of the display value differs as follows depending on the stability detection width.

- With b1: Around 1 count
- With b3: Around 3 counts

Countermeasures:

The following countermeasures are effective.

- Change the installation site of the balance to the location free from draft.
- Prevent the wind from entering directly into the weighing room when the door is opened.
- Open/Close the door a little.
- Open/close the door on the opposite side of the unit.

9.2.9 Some sound is heard from the balance

Cause:

The ABS series balance performs measurement with its lever slightly

vibrating.

Accordingly, if you listen carefully, you may hear the sound of the vibrating lever when the balance is placed at a quiet place or when something is loaded on weighing pan (1*).

However, if extremely loud noise is heard or only one unit among many makes unusually loud noise, check if the coil assy (25*) or other movable parts are not loose.

9.2.10 Nothing appears on the display

Cause:

The following may be considered as causes.

- Power is not supplied to the balance.
- Failure of power board assy (18*)
- Failure of digital board assy (19*)
- Faulty contact of the cables between the above board assys

9.2.11 The switches on the front panel do not work

Cause:

If all the switches do not work, the following may be considered as causes.

- The operation cable connected to digital board assy (19*) is disconnected or its faulty contact.
- Faulty digital board

If only one or two key/keys does/do not work, faulty switch unit(s) may be considered as the cause.

If only the PRINT key does not work, failure of the printer, power board assy (18*), and/or digital board assy (19*) may be considered as the cause.

9.2.12 The display becomes unstable when something is loaded on the pan

If the display becomes unstable only when something is loaded on weighing pan (1*), the following may be considered as causes.

- Static electricity is being applied to the sample or the sample container.
- Magnetic force is being applied to the sample or the sample container.
- There is a difference between the temperature of sample or/and container and that of the weighing chamber.

Even if one of the above is considered as the cause, confirm that the balance is normal as follows.

Turn ON the zero tracking function and press the TARE key with another sample or/and container loaded. If the weight display is stable, the balance is normal.

Hints of measurement:

- If static electricity is being applied to the sample and/or the container, covering them with the metal such as aluminum foil may produce good result.
- If magnetic force is being applied to the sample and/or the container, demagnetize them before measurement.
- Make the difference as little as possible between the temperature of sample and/or container and that of the weighing chamber.

9.2.13 Dispersion, fluctuation, zero drift, and poor return of zero point

If dust adheres to the movable part of the mechanism such as the balance lever, phenomenon such as dispersion, fluctuation, zero drift, and poor return of zero point may occur.

If something is wrong with the installation environment or sample(s), the similar phenomena will occur.

See “9.3.6 Dispersion, fluctuation, zero drift, and poor return of zero point” to find the cause.

9.3 Checkpoints

9.3.1 Detector assy position

For the position of detector assy (21*), see “6.2 Height adjustment of detector assy (21*)” in this service manual.

9.3.2 Leak and disconnection of the coil assy

To check the leak of coil assy (25*), remove the power cable and the J4 connector cable from the analog board assy (20*), and check the leak between each line at the small board that relays Pt-Ni band (15*) and coil assy (25*) and the force cell. If the tester needle in the maximum width moves even a little, you can judge that leak is occurring.

Disconnection of coil assy (25*) is rarely found except at the soldered portion. Check all the soldered portions related to coil assy (25*).

9.3.3 Display when the power is turned ON

When the power is turned ON, the display proceeds in the order of "CAL 2" → "CAL 1" → "CAL 0" → "CAL End."

You can seek the cause of a trouble by checking the time each display is appearing.

When "CAL d" appears:

When "CAL d" appears, any or all the "CAL 2/1/0" becomes long.

In this occasion, see "9.3.6 Dispersion, fluctuation, zero drift, and poor return of zero point."

9.3.4 Temperature sensor signal check

Select "tAd" in the service menu and let the balance display the temperature sensor signal (tAD value).

If the temperature sensor signal (tAD) is normal, it is displayed as follows.

- The value is around 15,000 to 16,000 at the room temperature of 20ºC.
- Approx. 260 counts increase per 1ºC raise of room temperature.
- The fluctuation width is within 2 counts.

When "A CAL" appears frequently:

ACAL appears when the value of the temperature sensor signal varies 130 counts from the value of previous span calibration.

This is equivalent to approx. 0.5ºC change in the room temperature. Judgement as to whether this is due to the installation environment or failure of the unit should be made from the change of ambient temperature and the change of this numerical value.

When "Err01" appears:

The temperature sensor signal (tAD value) must be 30,000 or more, or 5,000 or less.

When the value is 30,000 or more, the following may be considered as causes.

- Temperature sensor or its cable is short-circuited or leaks to the metal portion of the mechanical unit.
- The temperature sensor or detector assy (21*) is damaged.

When the value is 5,000 or less:

- The temperature sensor or its cable is disconnected.
- Failure of the temperature sensor, detector assy (21*) or analog board assy (20*).

9.3.5 Dispersion of span calibration

When the span values have dispersion every time the span calibration is performed, check the dispersion after span calibration.

When “CAL d” appears, press the [ON / OFF] key and let the balance display the weight value.

If the balance has dispersion when the weight is loaded on and unloaded from the weighing pan (1*), see “9.3.6 Dispersion, fluctuation, zero drift, and poor return of zero point.”

If the balance does not have dispersion when the weight is loaded on and unloaded from the weighing pan (1*), see “9.3.3 Display when the power is turned ON.”

9.3.6 Dispersion, fluctuation, zero drift, and poor return of zero point

Many possibilities such as failure of the balance, poor environment, problems with sample or the sample containers may be considered as causes.

If small dust, faulty soldering or faulty contact is the cause, it may be corrected temporarily when the case of mechanical unit is opened, but the same phenomenon may appear later.

If this kind of trouble occurs, roughly assume the cause of trouble before opening the balance case.

Actually check the balance as follows.

(1) Weights to be prepared:

With the maximum capacity of 220g/200 g	200 g weight
With the maximum capacity of 120 g	100 g weight

(2) Set the measurement conditions of the balance as follows.

Measurement mode	“St”
Stability detection width	“b1”
Zero trucking	“off”

(3) Perform measurement at around the zero point and at around the maximum capacity 7 to 10 times alternatively.

However, do not read the numerical value right after the stability

mark (→) appears, but read the value 20 sec after loading the weight on and unloading the weight from weighing pan (1*) respectively.

(4) Verify which of the following three patterns applies to the data in (3) and specify the cause.

- There is no dispersion around the zero point and around the maximum capacity.

  The following may be considered as causes.

  - The stability mark appears too quickly due to the influence of environment.
  - There is a problem with the sample or the sample container.
  - Failure of the balance which is not appearing currently.
  - Caused by vibration, but vibration is not occurring currently.

- There is dispersion similarly around the zero point and around the maximum capacity.

  The following may be considered as causes.

  - Failure of the balance
  - Caused by vibration.
  - Dust around weighing pan (1*) and pan support assy (3*)

- Dispersion around zero point is smaller than that around the maximum capacity.

  The following may be considered as the causes.

  - Failure of the electrical system of the balance
  - Caused by vibration
  - Eccentric error of the balance

10. PRINCIPLE OF MEASUREMENT

10.1 Magnet coil current value

With the ABS series, magnetic force balancing method is adapted as the principle of measurement.

With the magnetic force balancing method, the sample weight operates on one end of the lever which rotates and displaces around the fulcrum point, and the magnetic force is generated at the other end according to the sample weight to keep the lever at level.

As the size of this magnetic force is proportional to the amount of current that flows to the electromagnetic coil, the amount of the sample can be calculated from this current amount.

With the ABS series, the amount of current that flows to the electromagnetic coil is digitally calculated.

PID calculation is digitally performed on the A/D value of lever displacement and its result (electromagnetic coil current value) is returned to the analog amount (electromagnetic coil current amount) and is fed back to the mechanical system of the balance.

Adapting this method has realized high-resolution electronic balance using the A/D converter with relatively low resolution.

10.2 Temperature correction of the current value of electromagnetic coil

The current value of electromagnetic coil, unless the temperature is corrected, has the temperature coefficient of approx. 400 ppm/ºC due to the magnet inside the electromagnetic force generator.

Then the temperature coefficient of the electromagnetic coil current value is corrected within ±2 ppm/ºC with the following two-step correction means.

10.2.1 Temperature correction by the electric circuit

Reference voltage which has the temperature coefficient reverse to that of the magnet is supplied to the electromagnetic coil current generator, which corrects the temperature coefficient of the electromagnetic coil current value within ±30 ppm/ºC.

10.2.2 Temperature correction by software

By the temperature data obtained from the temperature sensor, the temperature coefficient of electromagnetic coil current value is corrected within ±2 ppm/ºC.

10.3 Linearity correction

Linearity is corrected by software.

First, all the area is corrected using a secondary equation (secondary correction) and the remaining error is corrected using a primary equation (primary correction) by 50 g increment.

10.4 Span calibration

The weight value to be displayed includes the error within ±2 ppm/ºC caused by the temperature coefficient.

To perform correct weight measurement, perform span calibration as necessary, taking temperature change into consideration.

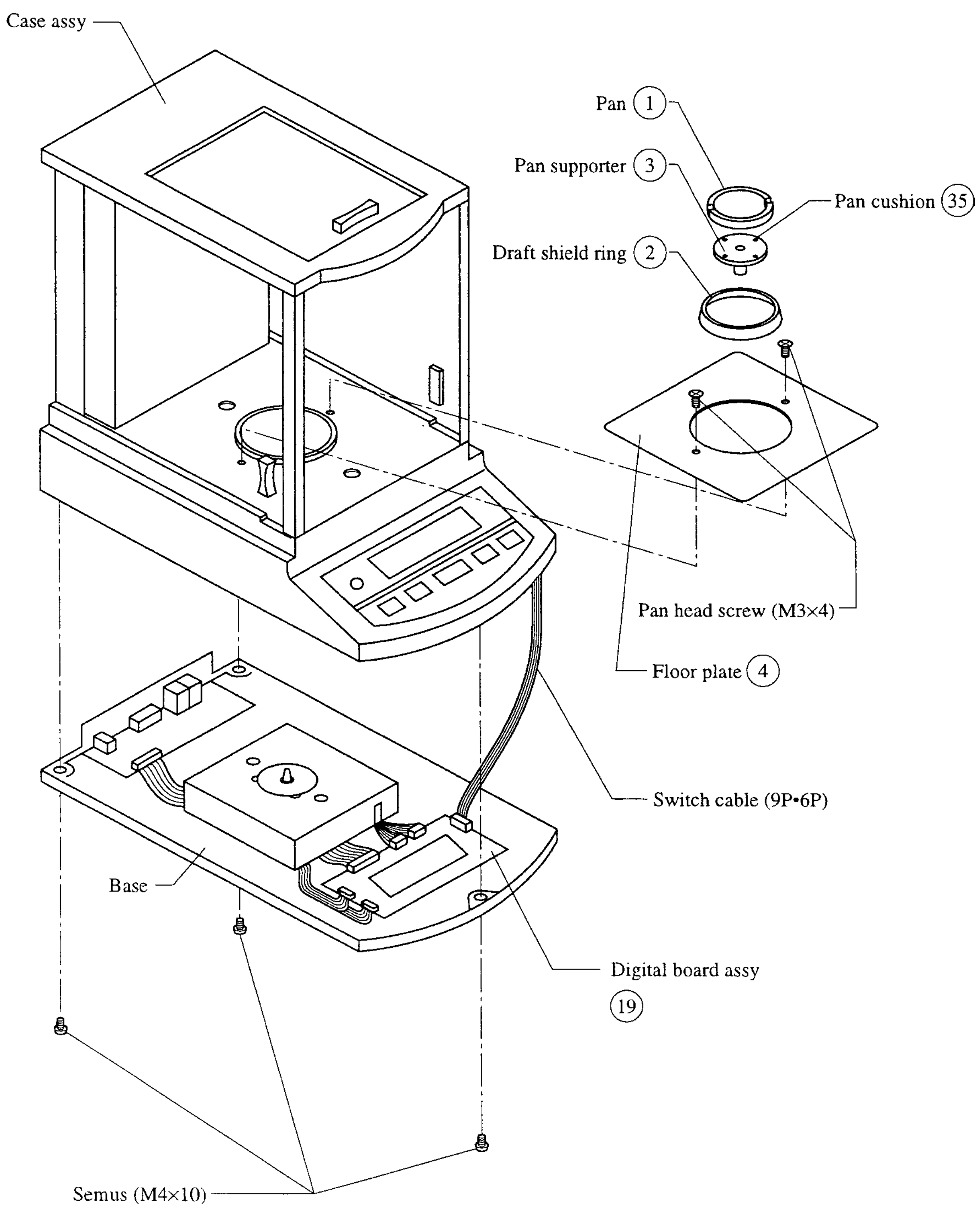

Case assy
Pan 1
Pan supporter 3
Pan cushion 35
Draft shield ring 2
Pan head screw (M3×4)
Floor plate 4
Switch cable (9P•6P)
Base
Digital board assy
19
Semus (M4×10)

Fig. 1

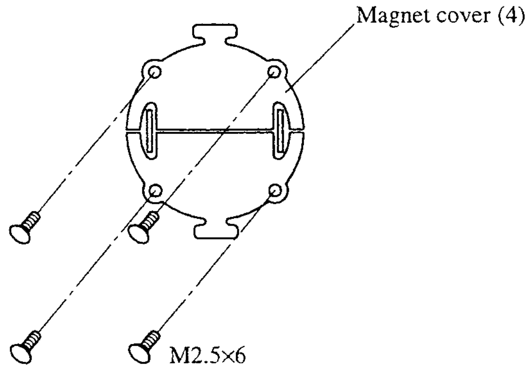


Fig. 2-1

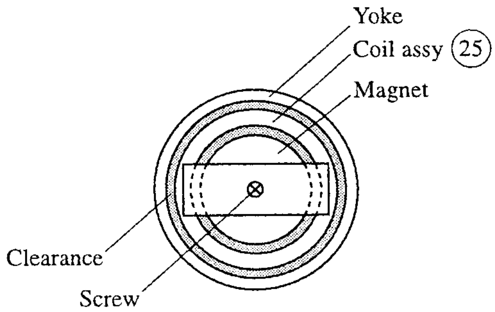


Fig. 2-2

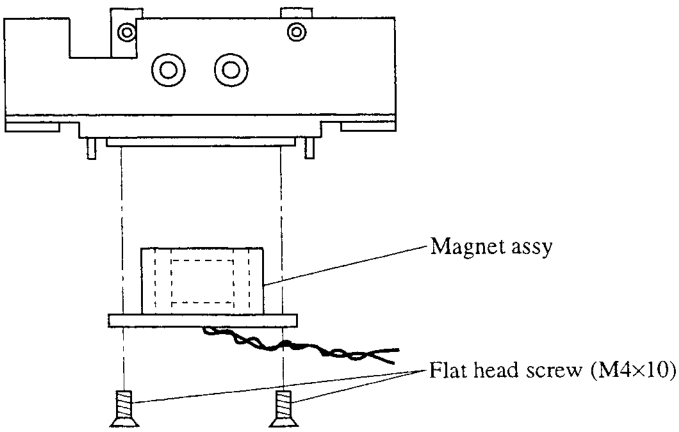


Fig. 2-3

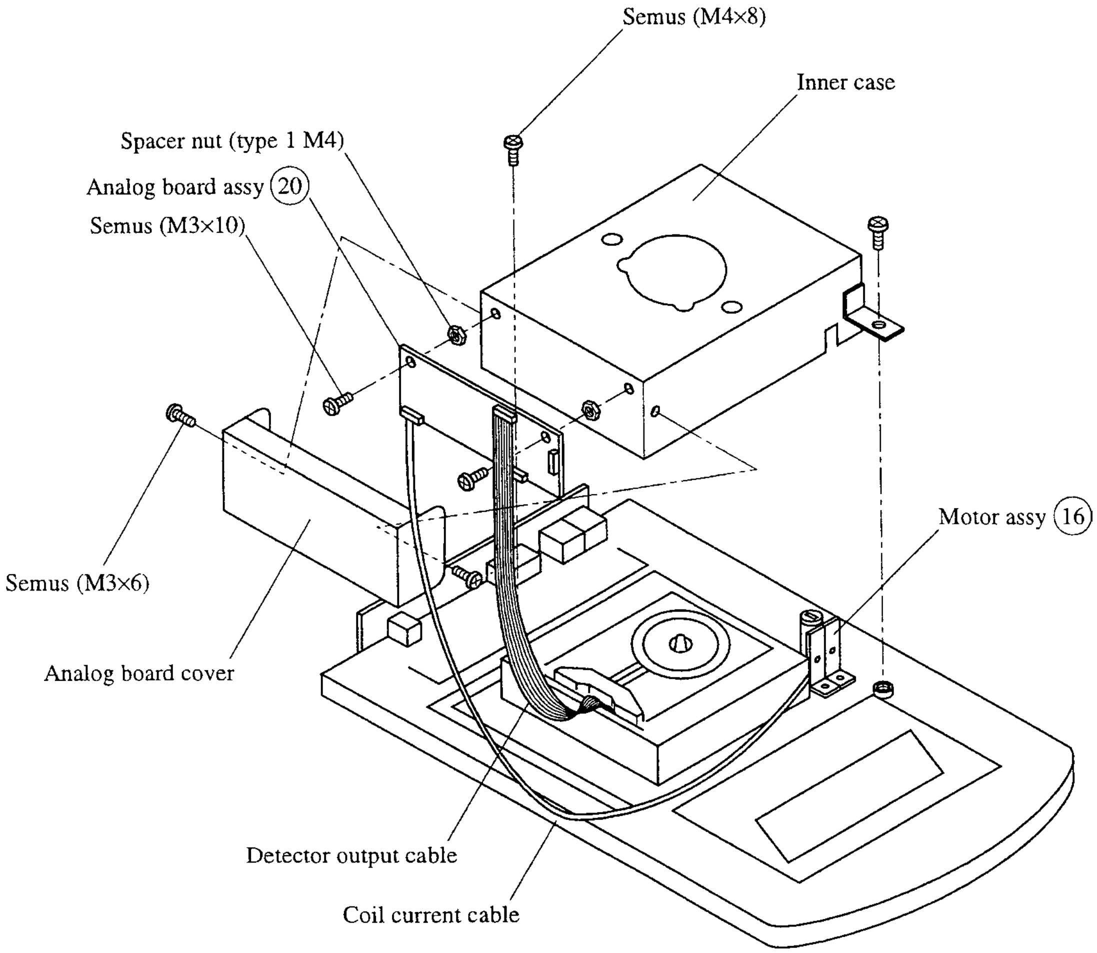

Semus (M4×8)
Inner case
Spacer nut (type 1 M4)
Analog board assy 20
Semus (M3×10)
Motor assy 16
Semus (M3×6)
Analog board cover
Detector output cable
Coil current cable

Fig. 4

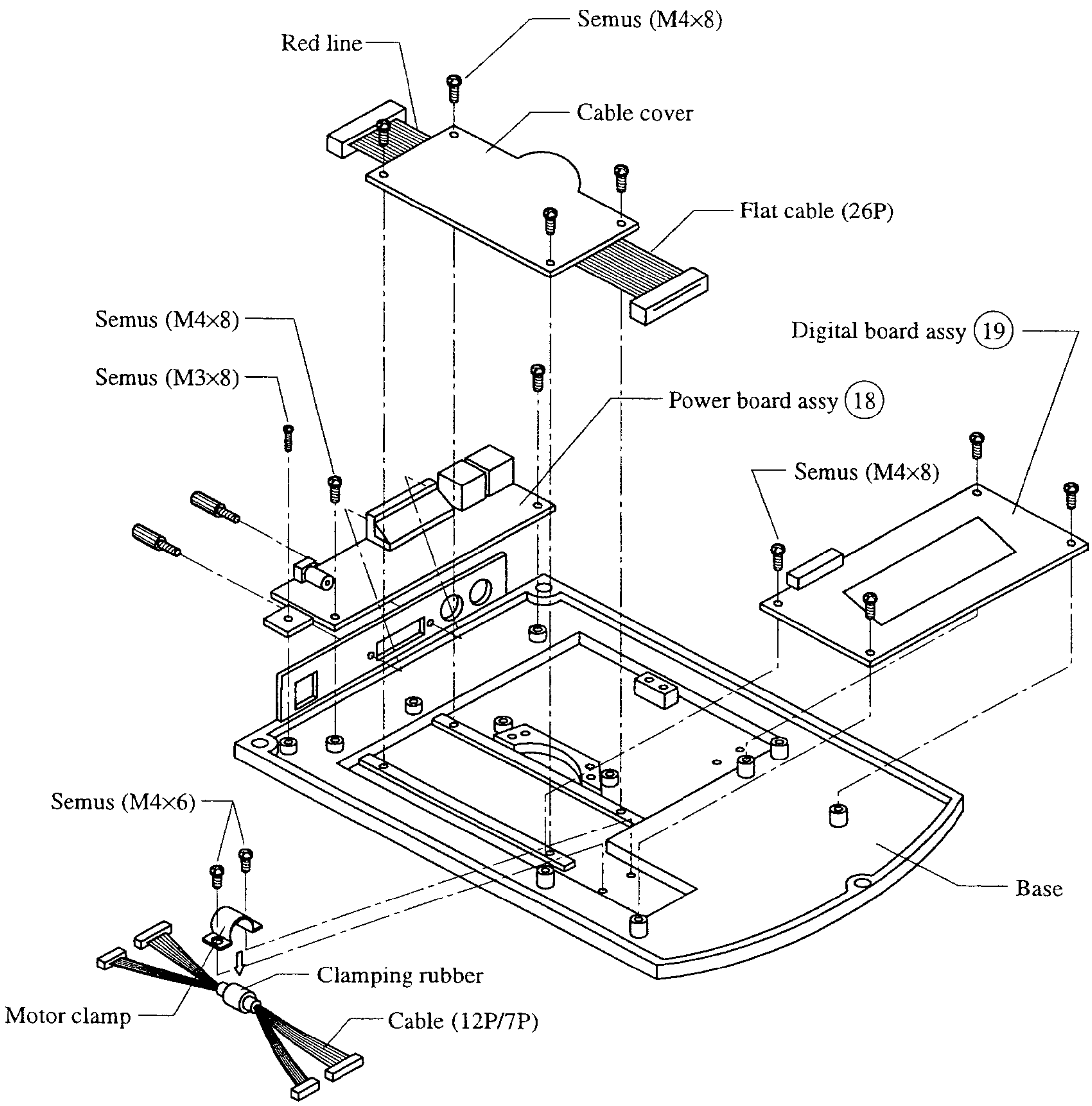

Semus (M4×8)
Red line
Cable cover
Flat cable (26P)
Semus (M4×8)
Digital board assy (19)
Semus (M3×8)
Power board assy (18)
Semus (M4×8)
Semus (M4×6)
Base
Clamping rubber
Motor clamp
Cable (12P/7P)

Fig. 5

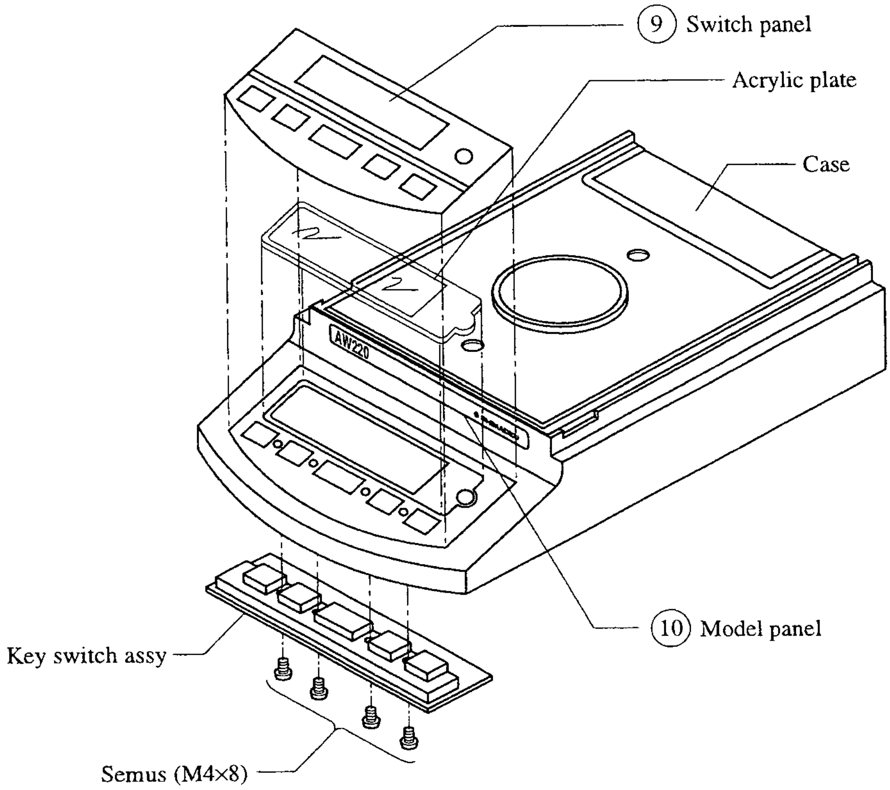

9 Switch panel
Acrylic plate
Case
AW220
10 Model panel
Key switch assy
Semus (M4×8)

Fig. 6

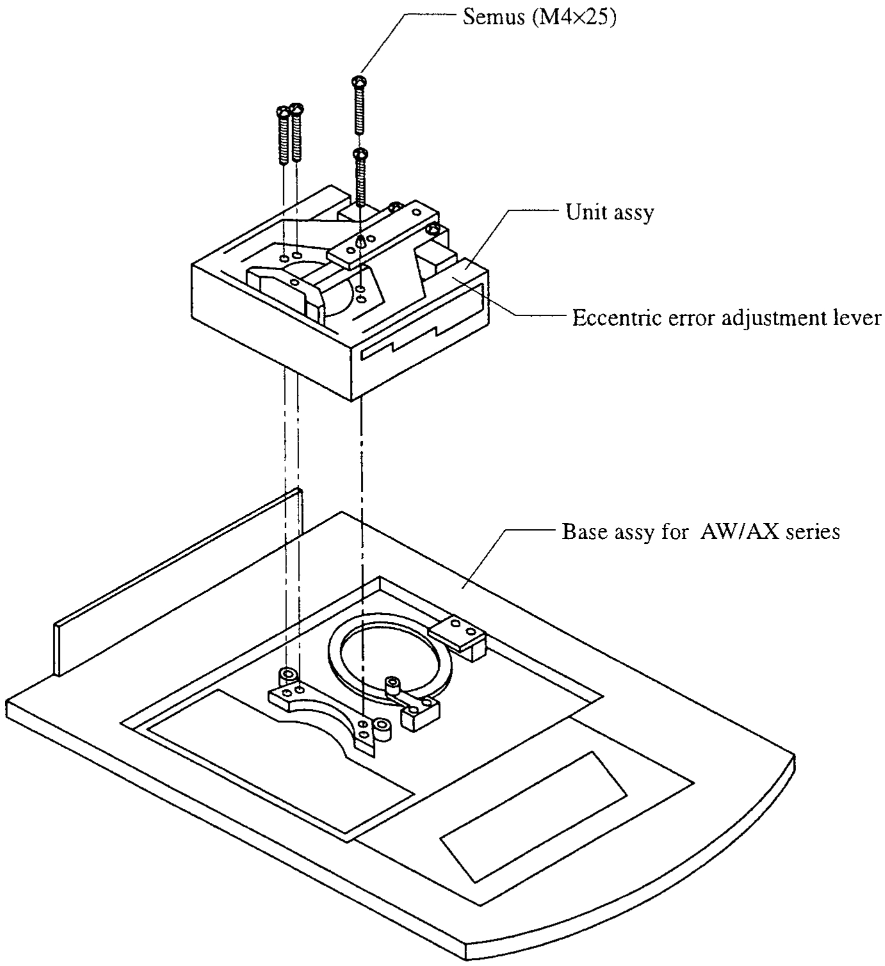
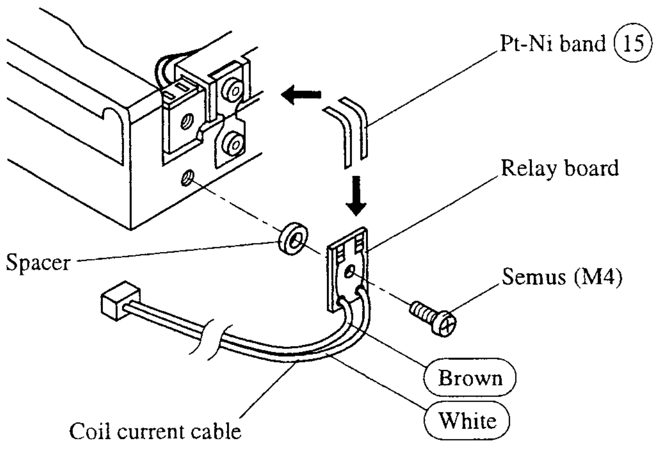
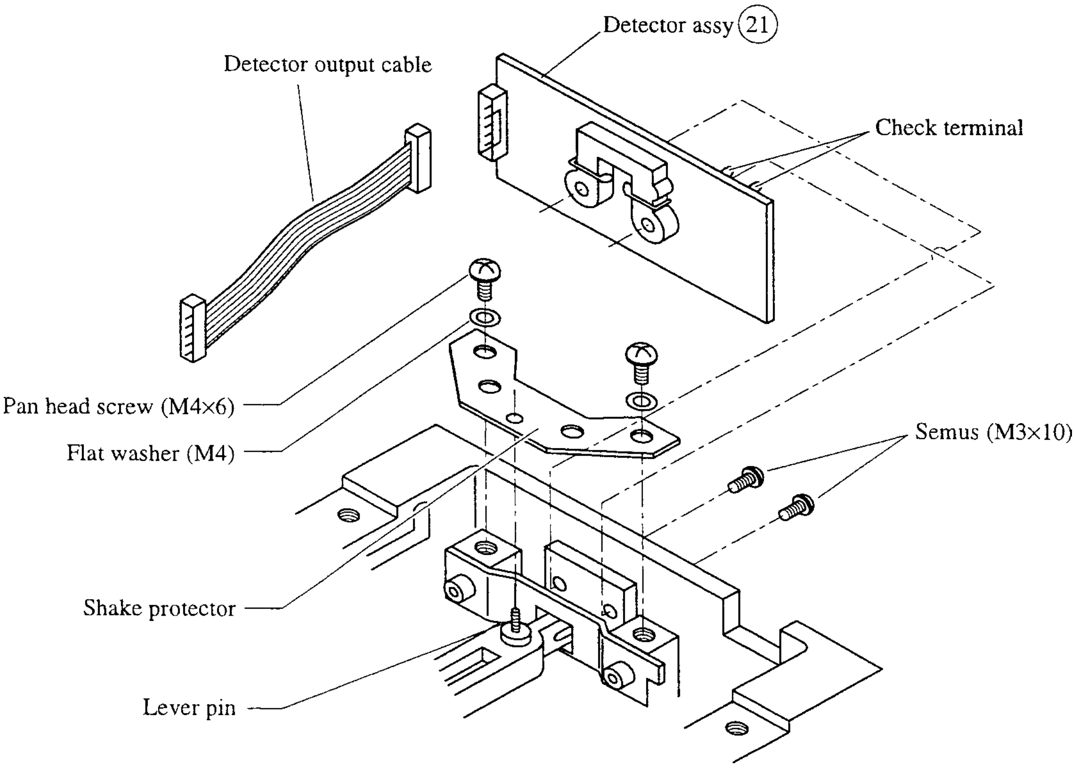

Semus (M4×25)
Unit assy
Eccentric error adjustment lever
Base assy for AW/AX series

Fig. 8



Pt-Ni band 15
Relay board
Spacer
Semus (M4)
Brown
White
Coil current cable

Fig. 9



Detector assy 21
Detector output cable
Check terminal
Pan head screw (M4×6)
Flat washer (M4)
Semus (M3×10)
Shake protector
Lever pin

Fig. 10

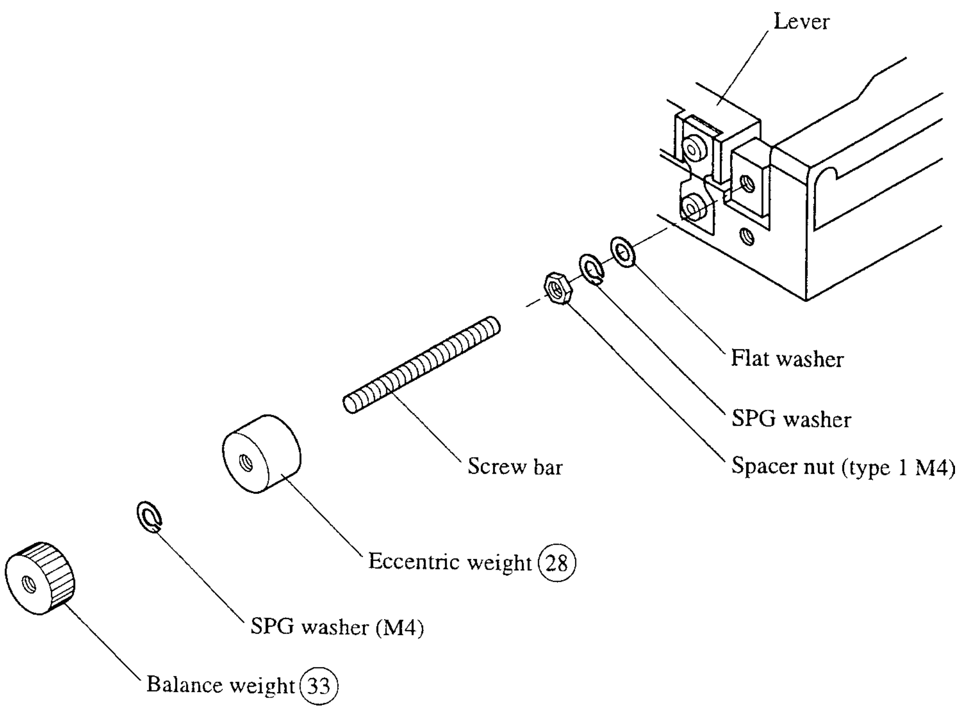

Lever
Flat washer
SPG washer
Spacer nut (type 1 M4)
Screw bar
Eccentric weight 28
SPG washer (M4)
Balance weight 33

Fig. 12

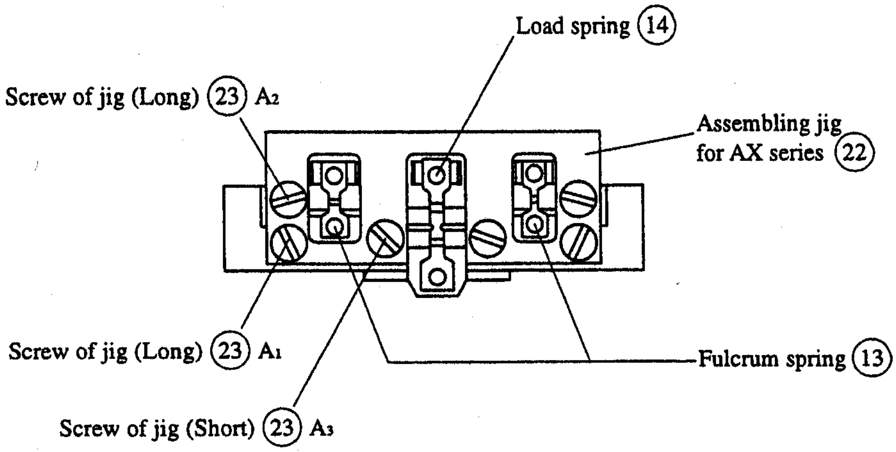

Load spring 14
Screw of jig (Long) 23 A2
Assembling jig for AX series 22
Screw of jig (Long) 23 A1
Fulcrum spring 13
Screw of jig (Short) 23 A3

Fig. 14

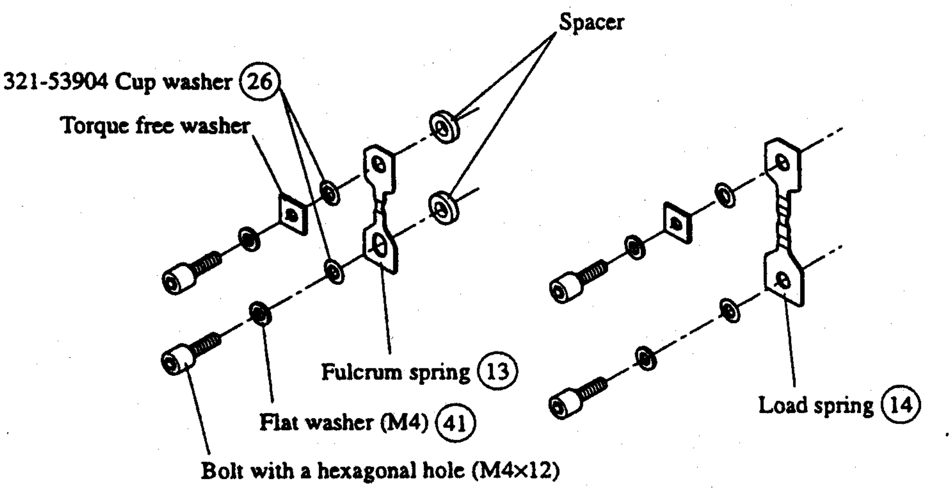
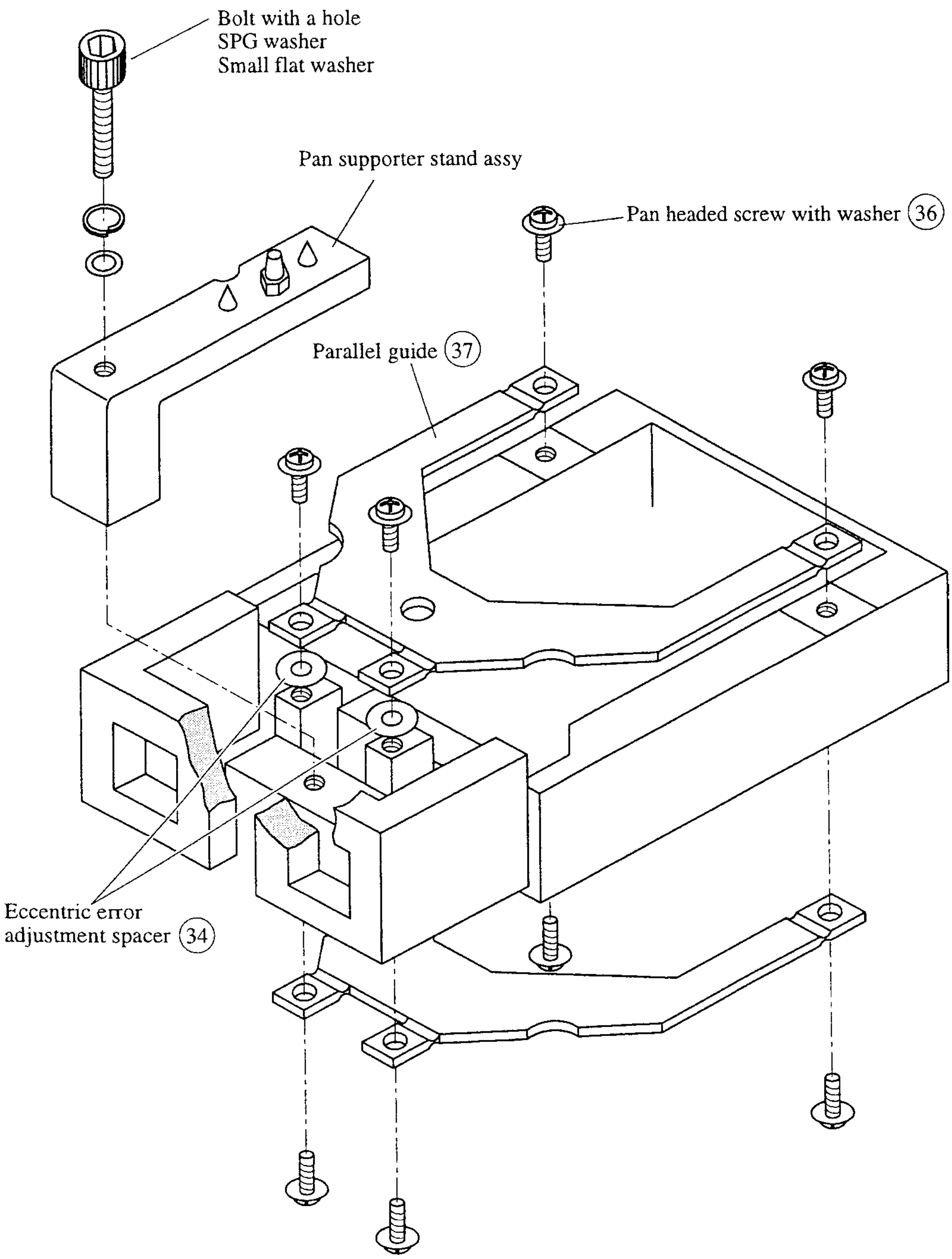

Spacer
321-53904 Cup washer 26
Torque free washer
Fulcrum spring 13
Flat washer (M4) 41
Bolt with a hexagonal hole (M4×12)
Load spring 14

Fig. 13



Bolt with a hole
SPG washer
Small flat washer
Pan supporter stand assy
Pan headed screw with washer 36
Parallel guide 37
Eccentric error
adjustment spacer 34

Fig. 15

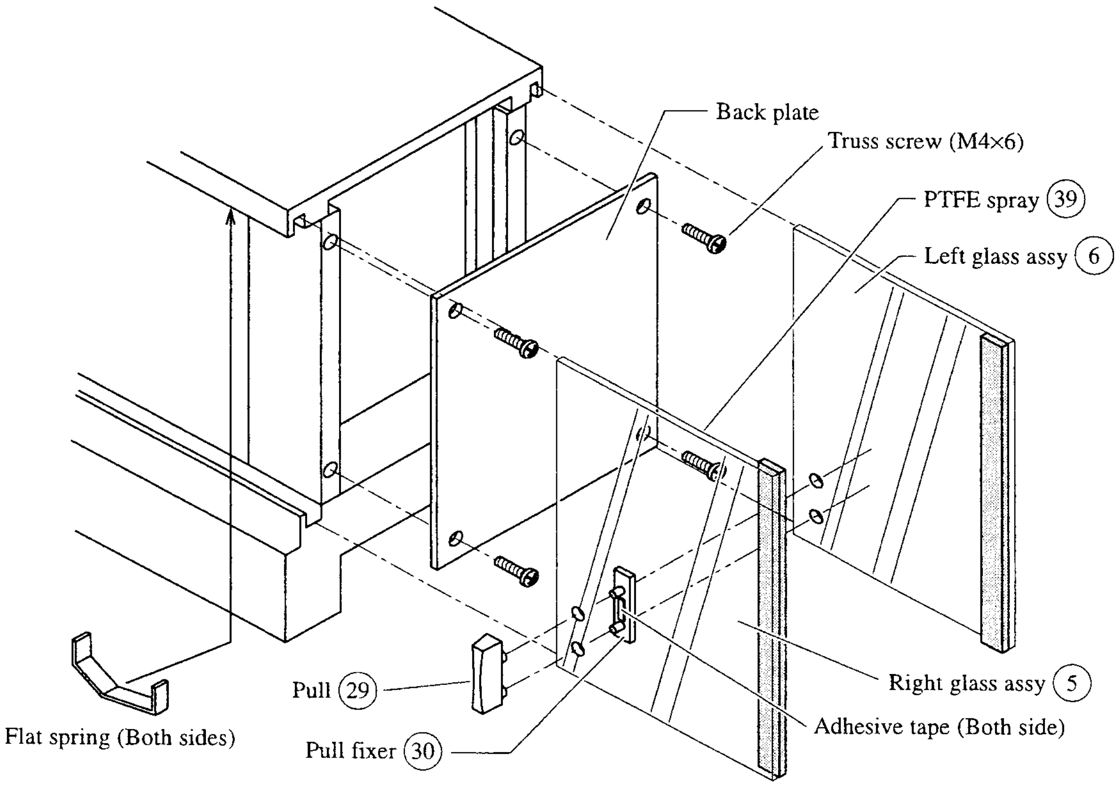

Back plate
Truss screw (M4×6)
PTFE spray 39
Left glass assy 6
Right glass assy 5
Adhesive tape (Both side)
Pull 29
Pull fixer 30
Flat spring (Both sides)

Fig. 16

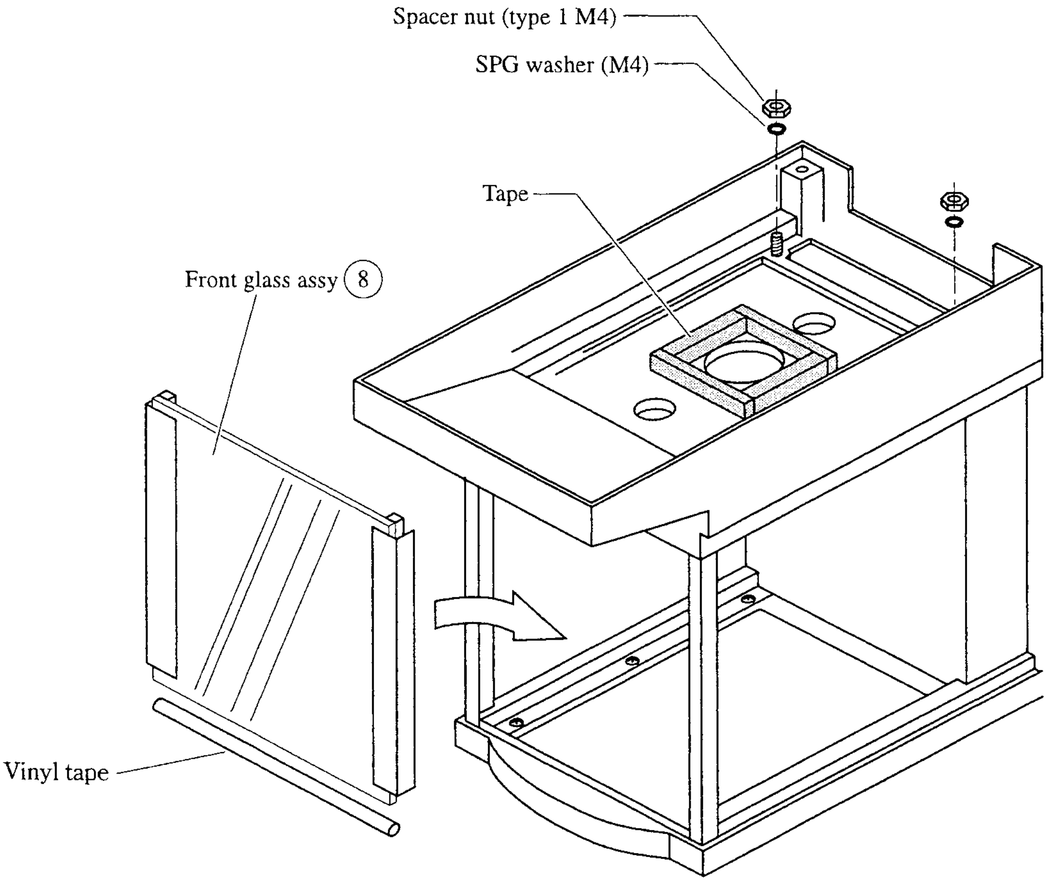

Spacer nut (type 1 M4)
SPG washer (M4)
Tape
Front glass assy 8
Vinyl tape

Fig. 17